

- Fig. 3. Larva of *Apaustus agraulia*. 3 a. Ditto, with covering formed of leaves. 3 b. Pupa.  
 Fig. 4. Larva of *Hypsa nesophora*. 4 a. Pupa.  
 Fig. 5. Larva of *Encemia caminæa*. 5 a. Pupa.  
 Fig. 6. Larva of *Philobota bimaculana*. 6 a. Ditto, with covering formed of leaves. 6 b. Pupa.  
 Fig. 7. Larva of *Gonionota pyrobola*. 7 a. Pupa.

XLVIII.—On a new Mode of Life among Medusæ.

By J. WALTER FEWKES\*.

SEVERAL pamphlets and one or two books have been written on the influence of parasitism in the modification of animal structure. Perhaps nowhere do we find this mode of life better illustrated than among certain of the Crustacea, where the anatomical structure is so masked by their parasitic habits that for a long time in the history of research it was impossible to recognize their zoological affinities, and it was only when the immature stages in the growth were studied and larval conditions, unaffected by parasitism, had been investigated, that the true relationships of the group could be discovered.

What we find in the so-called Lernean worms exists wherever parasitism is found among animals. It may, in fact, be concluded that ordinarily in parasites there is a degradation in structure, or at all events such a modification as to lead to important changes in anatomy and external form.

It would seem that among the lowest animals we ought to find a larger number of parasitic genera than among the higher. While there is little doubt that there is more variety in lower animals, I am not so confident that this mode of life has led to as great modifications in structure here as might be expected. While we cannot ascribe to parasitism the many variations in animal structure which occur, and it is impossible to give this mode of life a primary importance in theories of origin of species as has been attempted, it is no doubt true that many variations in structure have been derived either directly or by heredity from parasitic ancestors.

Nowhere among lower animals is there more likelihood

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that we should find parasitic conditions than among the Medusæ. Reflect for a moment that the young of a majority of these animals live attached to submarine objects, and it seems easy to see how, by changing its habitat, a parasitic attachment to another animal might easily take place. Considering the probabilities, however, although the number of genera which might be mentioned as living upon other animals is large, the number of recorded instances of those which have suffered a modification in structure by their attachment is very small.

Every one who has taken a hand in the most fascinating part of the study of marine zoology, viz. dredging in the ocean, knows how often ascidians, brachiopods, large mollusks, and other animals are brought up with attached hydroids growing upon them. These hydroids, in one sense, are not parasitic, as they draw no nourishment from their hosts, nor are they at all modified by their mode of life. For instance, *Hydractinia* from a *Natica*-shell inhabited by a hermit-crab is not unlike *Hydractinia* from the underside of a floating bell-buoy. *Obelia* from the stalk of *Boltenia* is specifically the same as *Obelia* on a submerged log. In these and similar instances, for they are numerous and varied in nature, there is no resultant modification either of host or parasite, as the attachment is in no way vital or intimate.

There are, however, among the Medusæ certain recorded cases of parasitism where there is a vital connexion, so to speak, where there is a parasitism or even commensalism of such an intimate character that not only the structure of the parasite but also even that of the host itself is modified. It is a study of these cases which has a most interesting morphological importance, for it affords in some instances at least a means of estimating the modifications of structure which may result in Medusæ from parasitic habits. They introduce into the discussion of the theory of evolution a series of facts which may well be carefully considered by those who regard selection as an all-important factor in the modification of animal structure.

It is not my purpose, however, to enter into a discussion of this subject, upon which so much has already been said by abler naturalists than myself. I have simply introduced it in preparation for the consideration of new observations bearing upon the question among the jellyfishes. Let me, as an introduction, mention a few instances of modification of Medusan genera by the mode of life called parasitism.

One of the best known instances of parasitism among Medusæ is that of *Cumina*, which lives parasitic in the stomach

of another Medusa, *Geryonia*. We undoubtedly have in this case a modification of the parasite by its peculiar mode of life in the host, although a reciprocal effect on the host is not recognizable.

Less known than *Cunina*, although quite as interesting, is the case of *Mnestra parasita*, a Hydromedusa which lives parasitic on the pelagic mollusk *Phyllirhoë*. We find here a modification in the structure of *Mnestra* by the attachment, although we know but little of the nature of that modification, while of the growth of the Medusa we know nothing.

A most interesting instance of parasitism and consequent modification among Medusæ is found in the problematical organism *Polypodium*. This undoubted hydroid is found parasitic in the ova of the sturgeon while in the body of the fish. We have in *Polypodium*, as described by Üssow, a hydroid-like animal, which develops and drops buds which can be directly compared with Medusæ. These are not the only instances of parasitic Medusæ thus far recorded, but they are typical and useful for comparisons. None of them are as valuable as they might be in estimating the amount of change in anatomy which has resulted, since we are either ignorant of their whole life-history or of that of related adults with simple development.

It is with the greatest pleasure that I am able to add to the above-mentioned instances of parasitism among Medusæ another of most extraordinary character. This instance is peculiarly adapted for the study of the effect of parasitism in modifying the Medusan structure, as its close allies are well known and comparisons with them can be easily made. This instance is, I believe, unique and the first recorded example of a Hydroid living attached to the outside of a fish and modified in structure by its life. It may thus properly be called a new mode of life among Medusæ.

In the pelagic fishing which has been carried on for the last ten years at the Newport Marine Laboratory we have taken several specimens of the well-known fish *Scriola zonata*, Cuv. This fish is a close ally of the ordinary "pilot-fish," and is often seen in calm weather swimming near the surface of the sea. Three of these fishes were found in company last summer, and upon the side, near the anal fin, of one of these, curious appendages were noticed which had never been observed before. On capturing the fish and making a superficial examination of the attachment I was reminded of an attached fungus growth. Every one is familiar with the growth on fishes of the fungus *Saprolegnia*, and the resemblance seemed so great, except in colour, between the supposed

fungus of *Seriola* and *Saprolegnia*, that at first I regarded the former as a fungoid growth. The colour of the supposed fungus of *Seriola* was, however, reddish and yellow; and, although I have since learned that superficial fungoid growths of this colour sometimes exist on fishes, at the time when *Seriola* was captured I was ignorant of this fact; the red colour led me to doubt its fungoid affinities. A glance at the supposed fungus through a small lens easily dispelled my error and showed me that I had a new and unique case of a parasitic Hydroid. It is to the peculiarities in structure of this animal and the Medusa which was raised from it that I wish to call attention in the present paper.

As the genus of Hydroids which shows this curious mode of life is new, it will be necessary to assign it a name, and I suggest that of *Hydrichthys mirus*, as expressing one phase at least of the curious life which it leads\*.

The majority of genera of Hydromedusæ have ordinarily two stages of growth, one of which is called the Hydroid and the other the Medusa-stage. The latter is a Medusiform zooid of the former. Let us consider each of these stages in *Hydrichthys*.

*Hydroid*.—The Hydroid of *Hydrichthys* consists of sexual and asexual individuals, both of which arise from a flat plate of branching tubes which is fastened to the sides of the body of the fish. The sexual individuals may be called the gonosomes, the asexual the filiform bodies.

The gonosomes consist of a simple contractile, highly sensitive axis, upon the sides of which are borne lateral branches with terminal clusters resembling minute grape-like bodies. These grape-like bodies are Medusæ in all stages of growth. The filiform individuals are simple flask-shaped bodies, without tentacles and with terminal mouths †.

*No circle of tentacles about a mouth-opening was detected either in the gonosomes or the filiform bodies.* This is a significant want, since, with the exception of *Protohydra*, *Microhydra*, and the secondary zooids of certain Alcyonians, tentacles of some kind are found near a mouth or in relation to the oral opening of most of the fixed Hydroids or polyps.

*Medusa*.—The gonophore of *Hydrichthys* has a *Sarsia*-like bell and manubrium, four radial tubes, four tentacles without appendages, as already elsewhere described by me ‡.

In the light of what we know of the affinities of the Medusa

\* An accurate diagnosis with figures will be found in my paper "On certain Medusæ from New England," Bull. Mus. Comp. Zool. xiii. no. 7.

† Somewhat like the spiral zooids in *Perigonimus* except this particular.

‡ Bull. Mus. Comp. Zool. xiii. no. 7.

of *Hydrichthys* it is interesting for us to consider those of the attached Hydroid. If our problem was to determine the relationship of *Hydrichthys* from a study of the Medusa alone, we could easily conclude that it is a near relative of *Sarsia*. Such a conclusion is, I believe, one which can be easily defended. When, however, we come to compare the Hydroid of *Sarsia* and the Hydroid of *Hydrichthys* we find the greatest differences between the two. These differences are so important that they have affected the whole structure; for a comparison of the two reveals the effect of the peculiar mode of life in *Hydrichthys*. The typical structure, or schema, of the Tubularian Hydroid, as *Coryne*, is a slender axis which may be naked or encased in a chitinous tube, an enlargement at the free end, and a terminal mouth-opening. This mouth-opening or the walls of the enlargement bear tentacles in rows, irregular or otherwise. Somewhere among these tentacles, or elsewhere on the stem, arise buds which may or may not develop into Medusæ. The widest variations from such a schematic type may be noticed among Hydroids. Our purpose here is to compare *Hydrichthys* with the so-called schema.

In the case of the gonosome of *Hydrichthys* I suppose that the stem of the schema remains, that the terminal mouth-opening is present, but that the enlargement of the axis has disappeared. From the sides of the axis arise lateral branches, as in some Hydroids, and the Medusa-buds have been crowded to the distal ends of these branches. Tentacles have disappeared on account of the parasitic nature of the life of the Hydroid. It is from this fact that we find in *Hydrichthys* the schema of the ordinary Tubularian Hydroid reduced to a simple sexual body or gonosome.

In the homology of the "filiform bodies" of *Hydrichthys* the reduction, as compared with the schema of a Hydroid, has gone still further, on account of the parasitic life, and nothing remains but a simple axis, without appendages of any kind.

If I am right in this homology of the two kinds of individuals in the *Hydrichthys*-colony, it would seem as if there ought to be a meaning for their simple structure as compared with the typical Hydroid. The relation of the Medusa to that of *Sarsia*-like genera would imply degeneration, not phylogenetic simplicity. Cannot we find in parasitism a cause for such a degradation?

Is the conclusion legitimate that these great differences between *Hydrichthys* and the fixed Hydroid closely related to it are the result of its peculiar mode of life? I believe it is. I believe that the modification in the Hydroid *Hydrichthys*, the

loss of tentacles, the polymorphism, and the increase in prominence of the sexual bodies, are exactly what we should expect to find *à priori* if a degradation had taken place in its structure.

There is one other point to which I wish to call attention before closing my communication. The existence of a polymorphism, such as we find in *Hydrichthys*, is exceptional among fixed Hydroids of the Tubularian group. Something similar exists in *Hydractinia* and *Perigonimus* and one or two other genera; but this kind of polymorphism is not common among fixed Hydromedusæ. A similar polymorphism exists, however, in *Veleva*, a floating Hydroid well known to all naturalists. In *Veleva* we have the basal plate with anastomosing tubes of *Hydrichthys* modified into a complicated float. The gonosomes are the same in both genera, the filiform bodies of *Hydrichthys* are represented by the single central polyp, so-called, in *Veleva*. The Medusæ of the two closely resemble each other. There are only two kinds of individuals in both genera.

Strangely enough, after I had reasoned out this likeness between *Veleva* and *Hydrichthys* on morphological grounds, my memory went back to a strange story I had once heard from an Italian fisherman of the origin of *Veleva* from the common mackerel. This story or a similar one long ago found its way into the books.

According to Marcel de Serres, the Mediterranean fishermen suppose that *Veleva* originates as a bud from the head of the mackerel; and Pagenstecher goes on to explain this error, after quoting its source, from the fact that young *Velevæ* are often found in the nets with the fishes, and it is easy to suppose, as their colour is similar, that one budded from the other. While we accept without question this explanation and the want of foundation of the fishermen's yarns, it is a strange coincidence that a possible relative of *Veleva* should be found attached to the body of a fish. It is well for us to inquire, in the light of phylogeny, whether *Veleva*, if it has not itself originated from Hydroids on the fish by budding, has not been directly derived from one which is so intimately related to *Hydrichthys*, which is attached to the body of a fish, that an unskilled observer might be easily deceived.

*Hydrichthys* is, in point of fact, the nearest known ally of *Veleva* among fixed Hydroids, and their morphological likenesses have already been pointed out. It would be premature to suppose, however, that *Veleva* has derived its peculiar anatomy from its descent from a form like the parasitic

*Hydrichthys*, rather than that *Hydrichthys* is a parasitic descendant of *Verella*; while the acceptance of the last-mentioned theory would lead us to regard fixed Hydroids like *Coryne* as likewise descendants of parasitic forms with which they have few resemblances. Indeed, we know next to nothing of the egg and early growth of either *Hydrichthys* or *Verella*. We have at all events found in *Hydrichthys* a nearly ally of *Verella* as far as the Hydroid is concerned, whatever may be the story told by the early history of both.

There is also another point long since known to those familiar with the literature of the Hydromedusæ, which is beautifully illustrated by *Hydrichthys*. Several naturalists have mentioned or called attention to the resemblance of the Medusæ of Hydroids of very different form. We may have Medusæ so nearly related as to be placed in the same genus, but their Hydroids would otherwise be placed in different genera. In *Hydrichthys* we have an illustration of this principle. The Medusa is similar to *Sarsia*, but there is only a remote likeness between the attached Hydroid *Hydrichthys* and *Coryne* the Hydroid of *Sarsia*. If a special student of the Hydroids was called upon to identify the parasitic Hydroid, he would consider its zoological distance from *Coryne* very considerable; but a study of the Medusa would lead him to a very different opinion of its zoological position.

Do these facts of a difference in the form of the Hydroids of allied Medusiform gonophores, or *vice versâ*, as sometimes happens, the diversity of Medusæ derived from similar Hydroids, mean anything morphologically? The question is an interesting one, and admits of several interpretations, which, however, it is not my purpose to consider at present. There is one thing which has a bearing on the subject, which I wish in closing to say in this connexion, viz.: *the true affinities of the majority of genera of Campanularian or Tubularian Hydroids, or of Leptomedusæ and Anthomedusæ derived from the same, cannot be definitely made out until both Hydroid and Medusa are studied together.*

XLIX.—*Notice of a remarkable Ophiurid from Brazil.*

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AMONG the specimens recently collected at Itamaraca, a few miles from Pernambuco, by Mr. Ramage, and forwarded to